Converter R/F

Tech. No. 4512 104 72313

FILING INSTRUCTIONS

File this documentation in binder:

SUBSYSTEM manual OPTIMUS R/F
SUBSYSTEM manual OPTIMUS RAD

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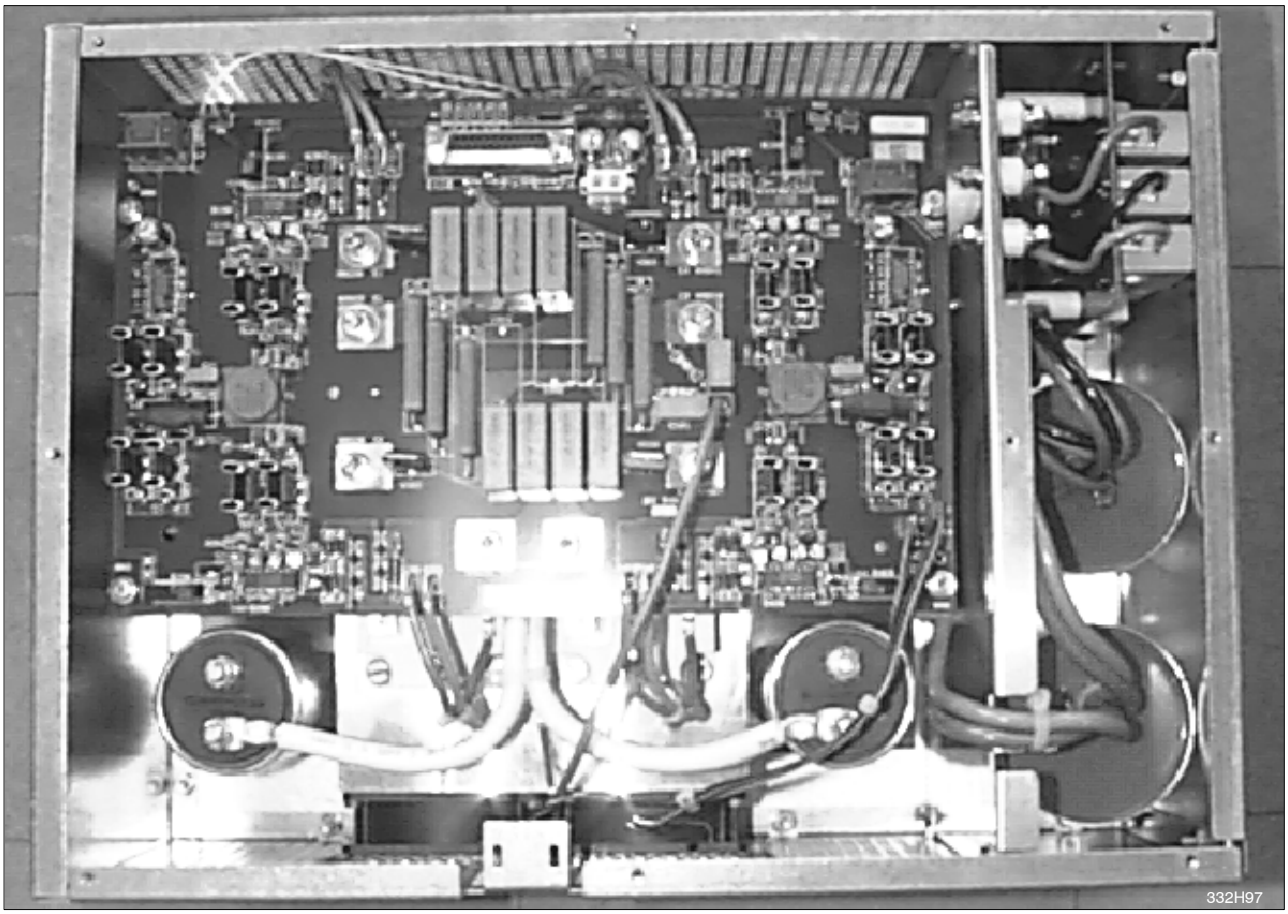
SERVICE MANUAL
742
UNIT

Converter R/F

Techn. No. 4512 104 72313



Converter assembly for the OPTIMUS generator

DMC Hamburg

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4512 984 07542

SERVICE MANUAL - UNIT

Converter R/F

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Techn. No. 4512 104 72313

In case there are any questions concerning this manual,
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File: Converter R/F_07542

List of pages and drawings (LOPAD)

Manual Order No: 4512 984 07542
released: 12/2001

0,5	223 mm	(rosa Karton)
1		
2		
3...12	(01.0)	
P-List	9890 000 02771	
Z1-1	(a/97.0)	A3
Z1-2	(99.0)	A3
Z2-1	(a/97.0)	A3
Z3-1	(96.0)	A4
Z3-2	(97.0)	A4

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Converter R/F

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kV power unit Z2-1

kV power S Z3-1

EMC Filter Z3-2

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1. Application/general

The converter R/F assembly (EQ and E2Q) is used in the OPTIMUS R/F and OPTIMUS RAD generators.

It contains the following functional units:

1. Mains rectifier unit to generate DC power supply for the converter
2. Converter to generate the AC input voltage for high-voltage generator EG
3. Interface for the control voltages of PCB “kV control” for activation of the converter IGBTs
4. EMC filter EQ200

2. Compatibility

- Base OPTIMUS R/F ≥ 9890 000 02161
- Surge arrester OPTIMUS ≥ 9890 000 02472
- Mains transformer 440/480V OPTIMUS R/F ≥ 9890 000 02601
  (Power distribution unit (PDU))
- Mains transformer 440/480V ≥ 9890 000 02301 for OPTIMUS RAD

3. Electrical connections going to the generator

Also see generator manual: Z2-1.x “Cabinet wiring E”.

Generator E	**Direction**	**Converter R/F**	**Remark**
EN K1:1	→	EQ X1101	Power supply 3x400 ... 480V ~
EN K1:3	→	EQ X1102	Power supply 3x400 ... 480V ~
EN K1:5	→	EQ X1103	Power supply 3x400 ... 480V ~
EN K2:41	←	EQ 200 X11	Discharging of DC circuit after switch-off of generator
EN K2:42	←	EQ 200 X13	Discharging of DC circuit after switch-off of generator
EZ X17	⇒	EQ X2	Low-voltage power supply / EZ102
EZ X24	⇔	EQ X1	Control signals / EZ 130
Power cable for H.V. generator :			
1. 50 kW version :			
EG X1002	←	EQ C3:1	1-converter version
EG X1003	←	EQ C13:1	1-converter version
2. 65/80 kW version :			
EG X1001	←	EQ C13:1	2-converter version
EG X1002	←	EQ C3:1	2-converter version
EG X1003	←	E2Q C13:1	2-converter version
EG X1004	←	E2Q C3:1	2-converter version

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4. Setting-to-work

Normally the converter has been installed in the generator and aligned at the factory. Special setting-to-work is not required.

4.1. Programming

The EMC filter EQ200 of the converter contains programming links for the Y capacitor.

The program settings depend on the type of supply mains of the generator.

When the generator is delivered from the factory this link is usually in position:

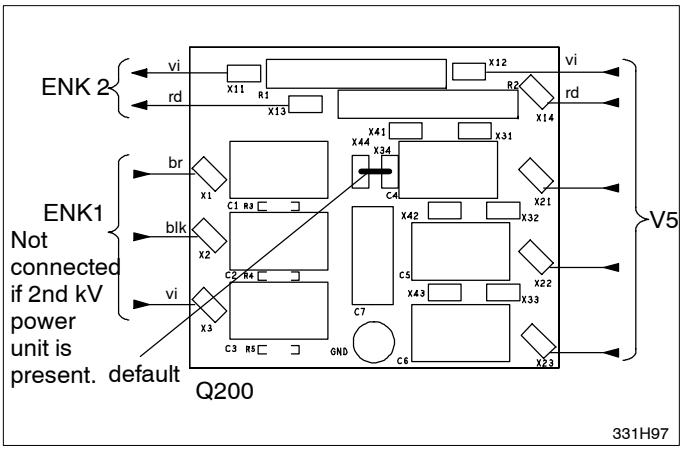
EQ 200 : X 34 ------ X44 (default).

Reprogramming is necessary only when a grounded delta mains is concerned!

See also Z1-1 "kV power unit" and Z1-2 "Mains supply of OPTIMUS R/F" of this manual.

The aim of this programming is to connect the Y capacitors C7 of the EMC filters Q200 in the converter assemblies to the grounded phase.

- Remove the front and right-hand metal covers from the converter assembly/ies EQ/E2Q.
- Remove EMC filter board(s) Q200.
- Remove the default link X34-X44.
- Connect the link to the ground phase as follows:
  - L1 grounded: X31 ---- X41
    or
  - L2 grounded: X32 ---- X42
    or
  - L3 grounded: X33 ---- X43



- Re-insert and connect the EMC filters.
- Fit the metal covers.
- Affix the supplied signs to the modified converter assemblies.

Types of mains supply of OPTIMUS R/F

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5. Fault finding

See drawings: Z1-1, Z1 "kV Control" of the generator manual

Z2-1

Z3-1

5.1. Problem overview

Resonant capacitor(s) defective:

- At least one of the two capacitors is ineffective:
  High voltage is not possible with the 50 kW version.
  Asymmetry or too low kV with the 65/80/100 kV versions.
- Short-circuit on one of the two capacitors (in case both capacitors are concerned, ENF1 is released):
  Low resonant-circuit frequency.
  The IGTBs can break because of overcurrent.
  Overvoltage at the resonant capacitor which is intact.
  kV overswing.
  DC short-circuit current possible because of resonant current which has not yet died off.

Snubber diode on kV power board defective:

- High impedance:
  IGBTs defective. DC short-circuit current causes the release of ENF1.
- Short-circuit:
  IGBTs defective. DC short-circuit current causes the release of ENF1. The resistors of the protective wiring might have been destroyed before.

The fan for the IGBT heat sinks fails:

The temperature is measured and a (warning) message is given via the software.
The converter is switched off when the limit values are exceeded (error).
This might be caused by failure of the supply of the fan.

The NTC resistor for temperature measurement is supervised via the software with respect to logical values.
The valid temperature range is between these error conditions.

Open/shorted measuring circuits or any values going beyond the temperature limits cause an error message.

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5.2. Hardware problems

An ENF1 tripout indicates that a serious problem has occurred in the converter. In such a case replace the converter as a whole.

- Before the ENF1 is pushed back to the ON position, check if all contacts of ENK1 1–2, 3–4 and 5–6 are open in the non-energized condition of the relay. If not, replace the relay before switching on ENF1 and proceed with other test activities.

The first thing to look at is the emitter-collector / emitter-gate impedance at every IGBT 1 to 4. If all 4 of a kV power unit are not 0 ohms (50 kW) and none of the 8 of a double converter generator is on 0 ohms, one should not suspect the power unit(s) (so far).

Is there any damage on the driver PCB(s)?

- Check the snubber diodes V 500 / 501 / 502 / 503 for short-circuit. If one has a short-circuit some of the resistors linked to the damaged diode(s) must also be open or have some overheat characteristics.

The second step should be the measurement of the rectifier(s) EQV5 (E2QV5). It could have been damaged from overvoltage (surge). Look for short-circuits and, after the next switch-on, for error codes 02HI and/or 02HJ (E_value out of range = DC power supply) in the error log index.

02HI = 470 V > E_value > 780 V in standby ≥ 30 ms
02HJ = 450 V > E_value > 800 V –dto– .

- Remove the driver PCB(s) to look at the current tracks for short-circuit (insulation damaged?)
- Check all 4 DC capacitors for short-circuit. Are the DC symmetry resistors R1 + R11 ok (47 k ohms)?
- Are the frequency capacitors C3 and C13 ok?
- If everything seems to be fine so far reinstall the kV driver PCB.
- Switch on ENF1.
- Switch on the generator.

With switch-on the converter DC supply is charged via the dumping (spring) resistors EN R1, R2 and R3. If there is still any kind of short-circuit in the machine that could not be measured with a (low voltage) Ω-meter and/or there is a part in the generator which fails when the AC or DC increases a certain level, one or two of the spring resistors might become very hot and open.

If it does not happen, measure the converter DC supply at ENK2 41(+) and 42(–). It should have a value between 480 V and 750 V.

If the generator is in a stable standby condition, proceed with the converter driver test without converter DC supply.

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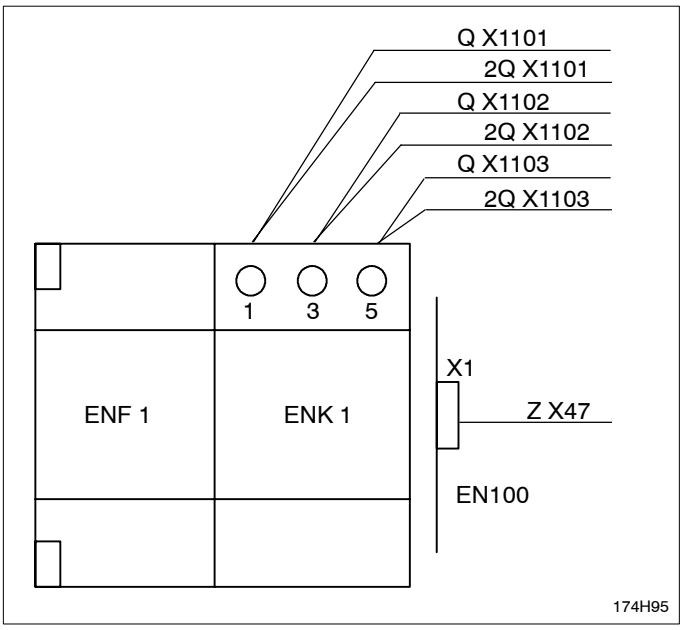
5.3. kV driver test

Caution!
Before this driver test can be carried out the kV power unit(s) must be disconnected from the mains supply
(leads of unit(s) EQ/E2Q to ENK1 :1, :3, :5).

This safety measure is also valid for the chopper test to guarantee that the measurements can be carried out without any risks involved.



- Switch on the generator.
  Ignore error codes 02HI and 02HJ now, the DC supply is off and these errors must come up.
- Check whether the gate voltage is about –14.2 V ±0.3V against emitter for every IGBT.
- Check the ±15 V supply for the IGBT drivers. Drivers 1 and 2 are supplied by chopper 1 while drivers 3 and 4 are supplied by chopper 2. The common zero point is the emitter.

Emitter	+15 V supply at heat sink	–15 V at resistor
E1, X101	A100 : 3	X102
E2, X201	A200 : 3	X202
E3, X301	A300 : 3	X302
E4, X401	A400 : 3	X402

The kV driver test is software controlled via PC. Due to the missing PREP and exposure requests the signals **EN_X_C**/ and **CTRL_X_C**/ have to be set low-active at the backpanel at locations **X76** and **X74**
(see drawing Z2–5.1/2).

Caution!
Do not forget to remove these connections after the test. Otherwise kV start immediately with the PREP command in normal application mode.

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Test of control signal(s) and driver(s) behavior:

The range of the control signal is + 3.7 V ± 0.2 V for the ON condition and + 1.2 V ± 0.2 V for the OFF condition at the specified measuring point against generator ground (see schematic diagrams and PCB layout).
The range of the driver signal (gate against emitter) is – 14.2 V ± 0.3 V for the OFF condition and + 13.5 V ± 0.3 V for the ON condition.

- Select menu ***"FU_kV/ Faultfind/ Functional Test/ Test Converter"*** at the service PC.
  The question **[power supply mains – E disconnected ?:]** comes up.
  Answer with "yes" (type Return twice) and transmit with [F2].

If the test takes longer than 10 minutes it may happen that the test is denied by the kV control. This happens if the DC voltage = E-value is ⩾ 5 V (the DC capacitors are slowly charged by the ± 15 V of the drivers). Then short-circuit the DC at collector C1 and emitter E2.

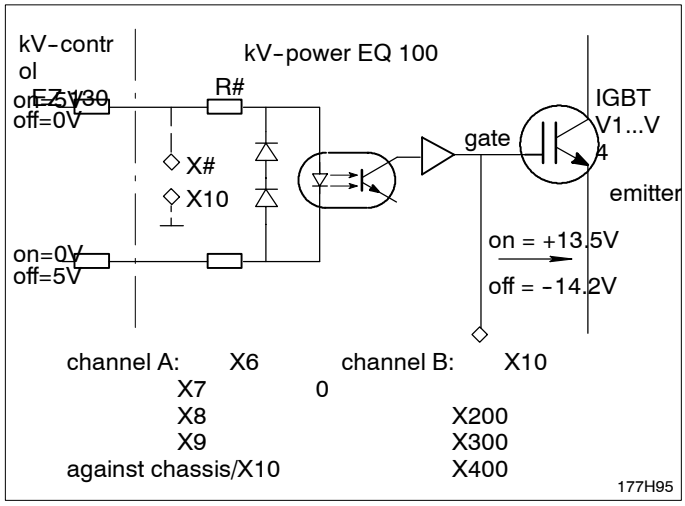
Do not establish a constant short-circuit to avoid problems after the test!

The test itself is short. The pulse time is 2.5 s long, but the PC screen displays **[completed]** after 5 s.
kV_control sends pulses for 5 s, but the hardware timer on the kV_control inhibits more pulses after 2.5 ms. Within this time the actual kV must be on the nominal value.

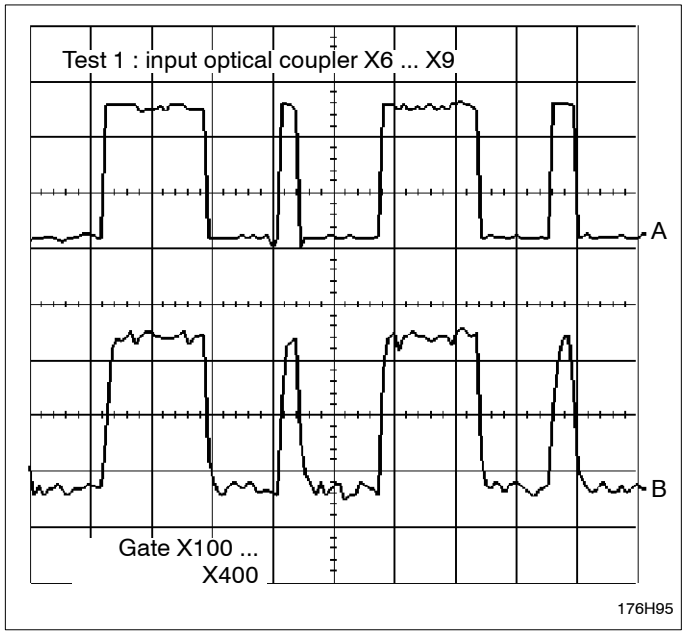
Test 1: Optical coupler / activation of the gate

Test 1: in- and output:

- Put a 2-beam oscilloscope to every measuring point of the control signals (channel A) and to every gate belonging to the inputs (channel B). Measuring points X6...X10 are present at the kV power unit.
- Trigger with the negative slope of channel A, take 10..50µs/Div.



The wave form of the oscilloscope screen shot depends on the resolution of the oscilloscope.



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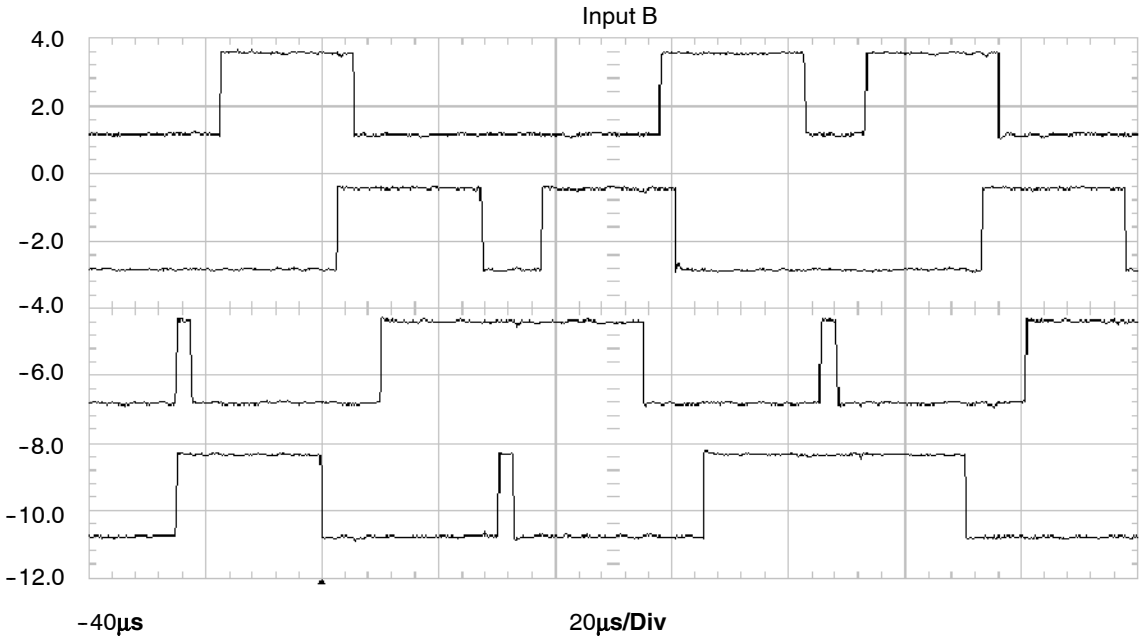
Test 2: Activation sequence of the gates: Inputs only

Test 2: inputs only:

- Check if the signal pattern of all 4 control signals look the same as on the diagram. Of course, only 2 channels can be seen at the same time, but the ”ONs” and ”OFFs” **must** be equal to the drawing.



Signals from top to down, voltage scale for Ch1 only, active state high:

Ch 4	=	Y100	x8	gate IGBT V3			
Ch 3	=	Y100	x7	gate IGBT V2	Average	high level =	+3.6V
Ch 2	=	Y100	x9	gate IGBT V4	Average	high level =	+1.2V
Ch 1	=	Y100	x6	gate IGBT V1			

Whenever IGBT signals x6 (V1) + x9 (V4) or x7 (V2) + x8 (V3) are active high new energy is driven into the system.
V1 + V2 or V3 + V4 must never be active high = on together.

Test 3: Comparison of control signals of EQ with E2Q: only for ≥ 65 kW

Test 3: only for 65/80/100kW with two kV power units:

- Compare control signals of both units.
  The signals at R25 of unit 1 must be absolutely equal to the signal at R25 at unit 2.

If no problems are visible = all wave forms are as they should be:

- Switch off the generator with **ENF1**.
- Remove links **EN_X_C**/ and **CTRL_X_C**/ at the backpanel **X76** and **X74**.
- Remove oscilloscope probes.
- Close the kV power part(s).
- Connect mains power lines at ENK1 :1 :3 :5.

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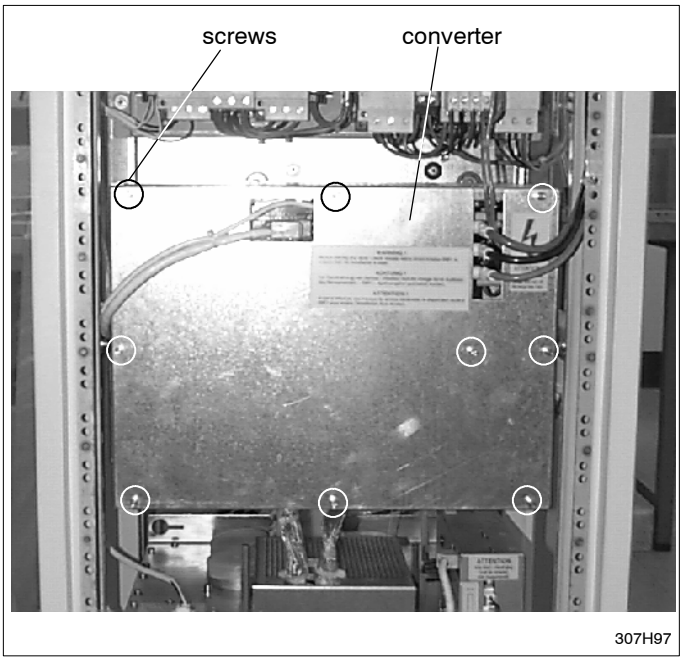
- Switch on ENF1 and the generator.

6. Replacement

When the converter has been exchanged, the alignment ”Function unit kV” must be repeated.
For this work refer to ”Adjustments” of the generator manual.

- Remove the cover (loosen 9 screws).

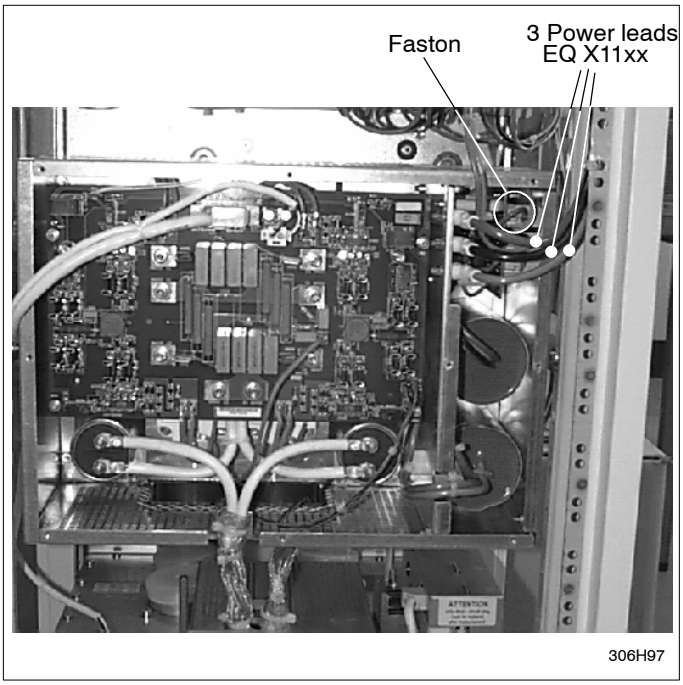


- Remove 2 fast-on plugs from Q 200:
  - Q 200 X11 (from NK2:41, vi)
  - Q 200 X13 (from NK2:42, rd)

  Function: Discharging the power C of EQ.

- Unscrew the 3 power leads (M8):
  - EQ X1101 (from NK1:1, br)
  - EQ X1102 (from NK1:3, bk)
  - EQ X1103 (from NK1:1, vi)

  Function: Power supply for converter EQ.



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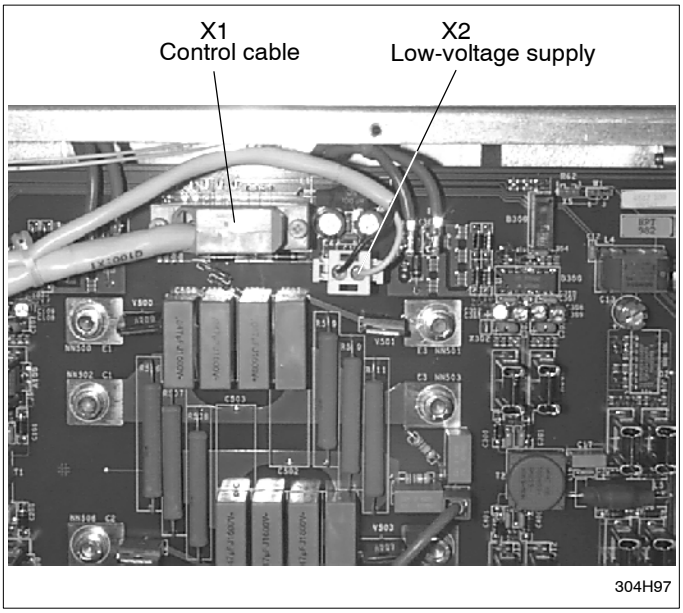
- Loosen connector X2.

  Function: Low-voltage supply EQ 100.

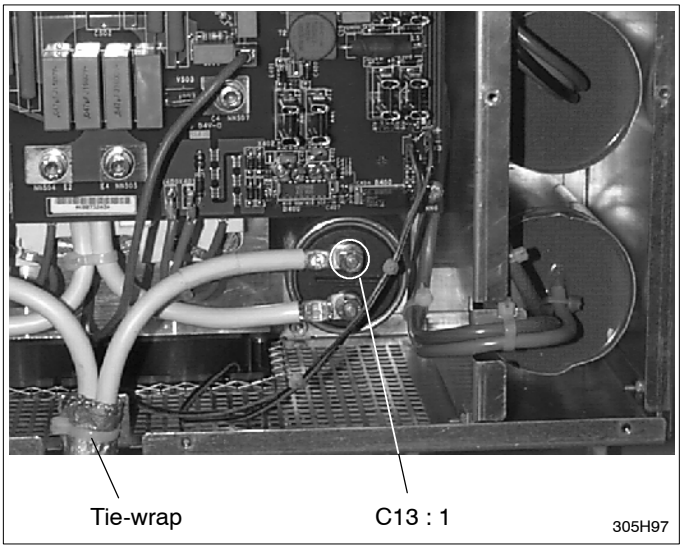
- Loosen connector X1.

  Function: Control leads EQ 100.



- Loosen the 2 power cables going to the H.V. generator (M10):
  - Q C3 :1 (to GX 1002 or 1004)
  - Q C13:1 (to GX 1001 or 1003)

- Remove the tie-wrap.



- Remove the converter assembly from cabinet E (2 screws on the left and right).
- Install the new converter proceeding in reverse order as described above.
  Also see: Z2-1.2 Cabinet wiring
  Z1-3.2 kV power unit

Caution!
When the new converter is installed "Function Unit kV" must be re-aligned. For alignment work refer to section "Adjustments"of the generator manual.

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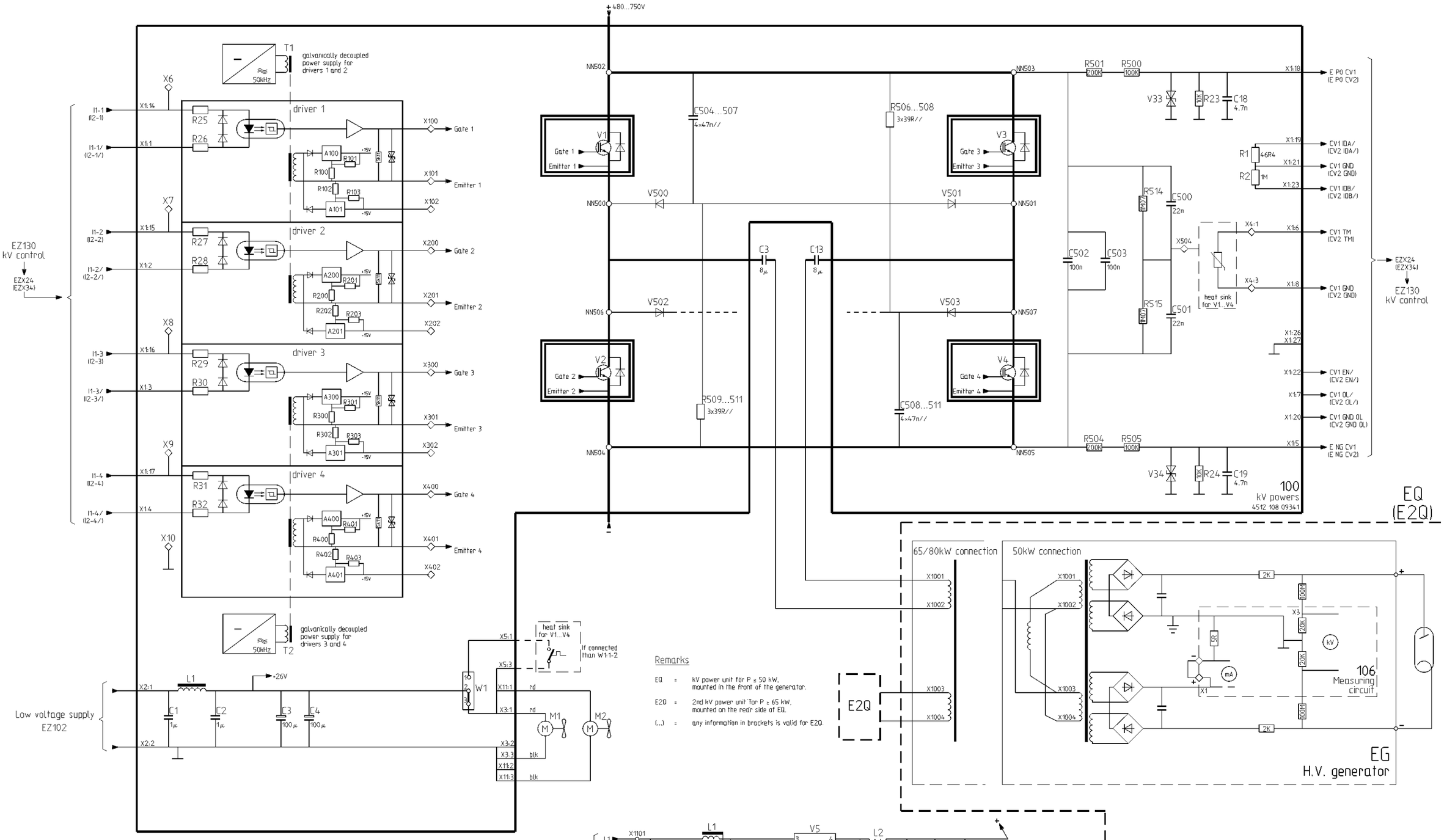
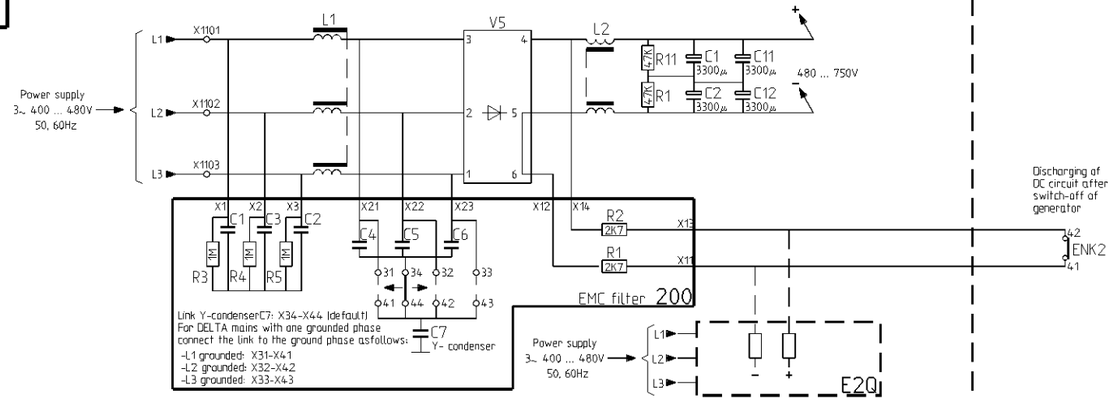


Remarks

EQ = kV power unit for P ≤ 50 kW, mounted in the front of the generator.

E2Q = 2nd kV power unit for P ≤ 65 kW, mounted on the rear side of EQ.

(...) = any information in brackets is valid for E2Q.



kV power unit

Z1-1

Mnemonics

E NG CV1	E value converter power part 1 DC supply negative
E NG CV2	" " " " " 2 " " "
E P0 CV1	E value converter power part 1 DC supply positive
E P0 CV2	" " " " " 2 " " "
CV1 EN/	converter power part 1 enable
CV2 EN/	" " " 2 "
CV1 GND	converter power part 1 ground
CV2 GND	" " " 2 "
CV1 GND OL	converter power part 1 ground overload
CV2 GND OL	" " " 2 " "
CV1 IDA/	converter power part 1 identification
CV1 IDB/	" " " 1 "
CV2 IDA/	converter power part 2 identification
CV2 IDB/	" " " 2 "
CV1 OL/	converter power part 1 overload
CV2 OL/	" " " 2 "
CV1 TM	converter power part 1 temperature
CV2 TM	" " " 2 "
I1 1 / I1 1/	IGBT1 power part 1
I1 2 / I1 2/	IGBT2 power part 1
I1 3 / I1 3/	IGBT3 power part 1
I1 4 / I1 4/	IGBT4 power part 1
I2 1 / I2 1/	IGBT1 power part 2
I2 2 / I2 2/	IGBT2 power part 2
I2 3 / I2 3/	IGBT3 power part 2
I2 4 / I2 4/	IGBT4 power part 2

Converter R/F (a/97.0)

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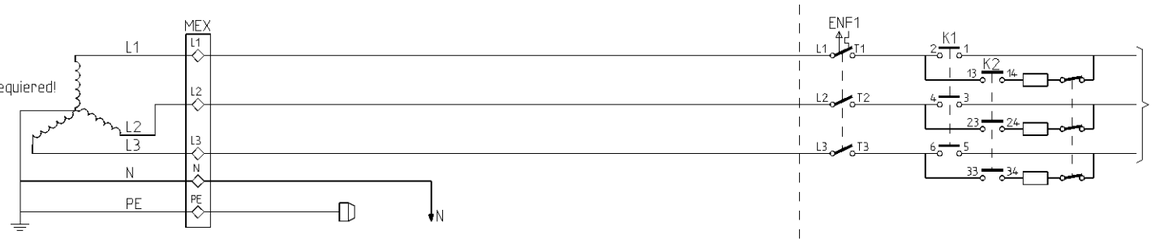
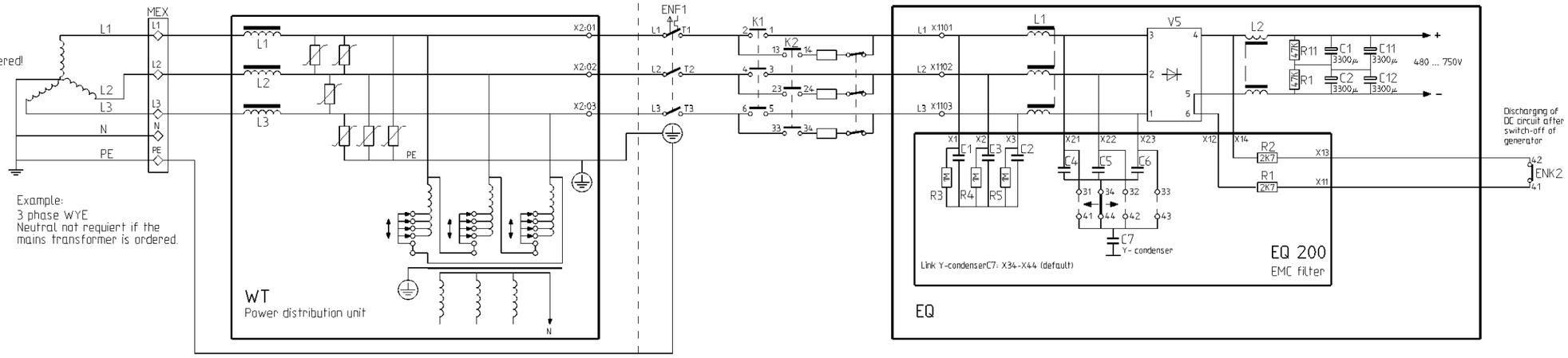
A1/A3 97-09-01 Schr.
ua1097

3 phase WYE:
Mains transformer is not requiered!

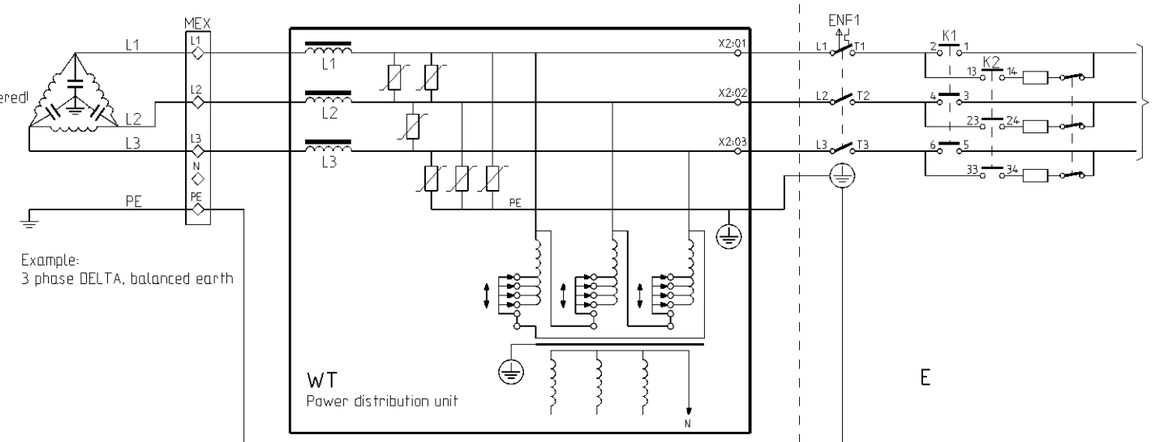


3 phase WYE>400V:
Mains transformer is requiered!



Example:
3 phase WYE
Neutral not requiert if the
mains transformer is ordered.

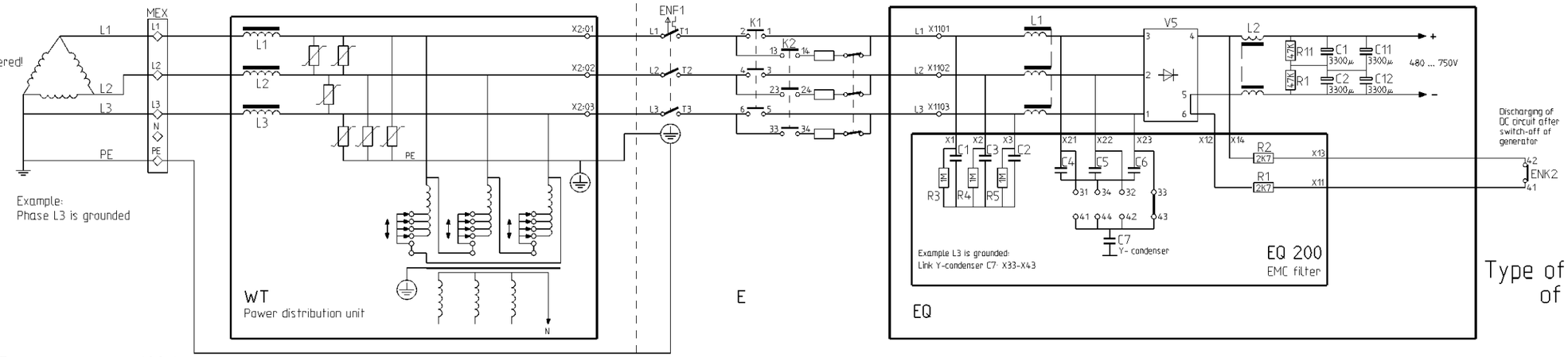
3 phase DELTA,
balanced or earth:
Mains transformer is requiered!



Example:
3 phase DELTA, balanced earth

E

3 phase DELTA, grounded:
Mains transformer is requiered!



Example:
Phase L3 is grounded

E

A1/A3 99-02-10 Schr.
u01098

Type of mains supply of OPTIMUS R/F

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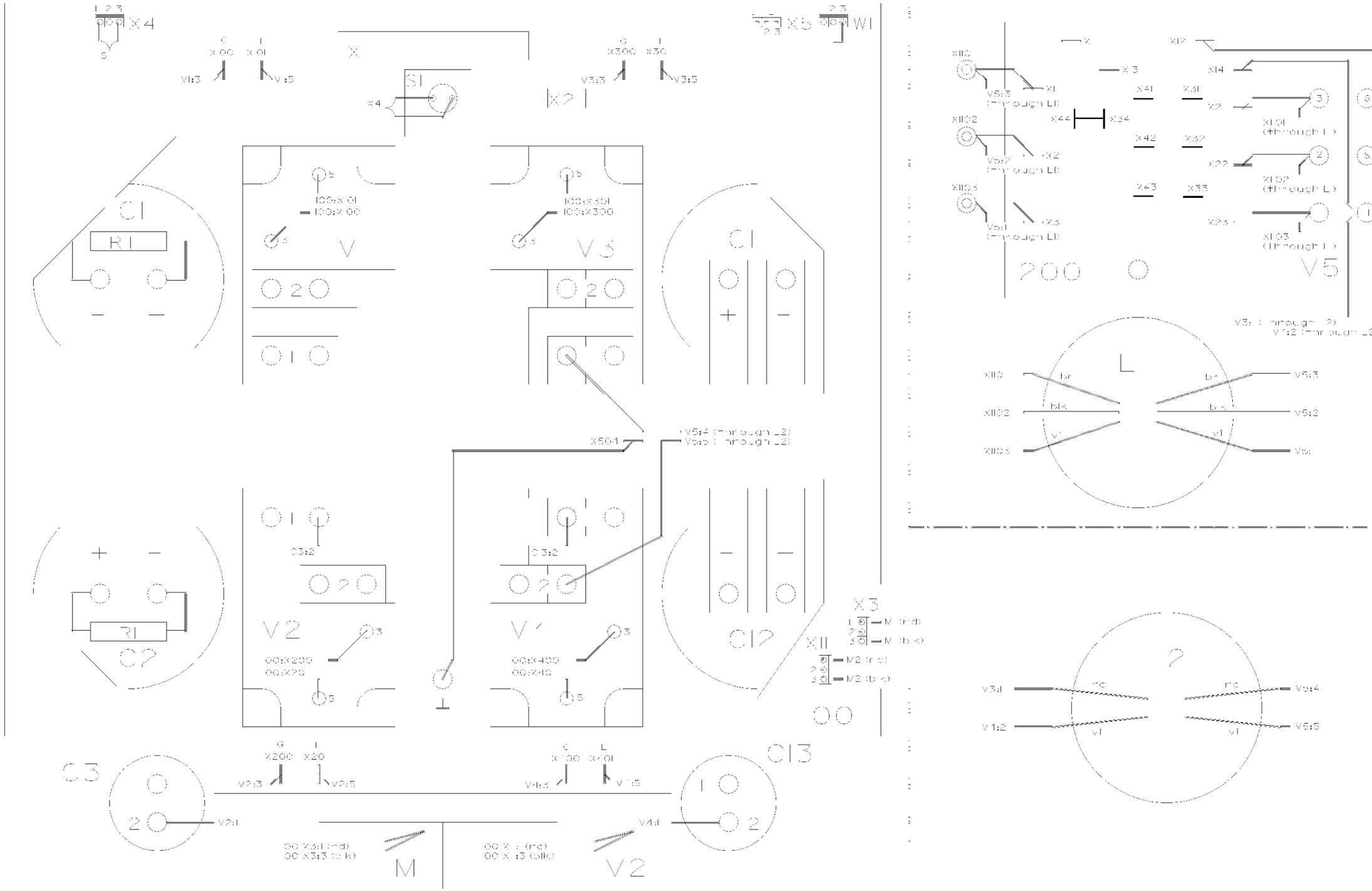

A3/A3 97-09-01 Schr.
ua0951

Q/2Q
kV power unit
4512 104 7231.

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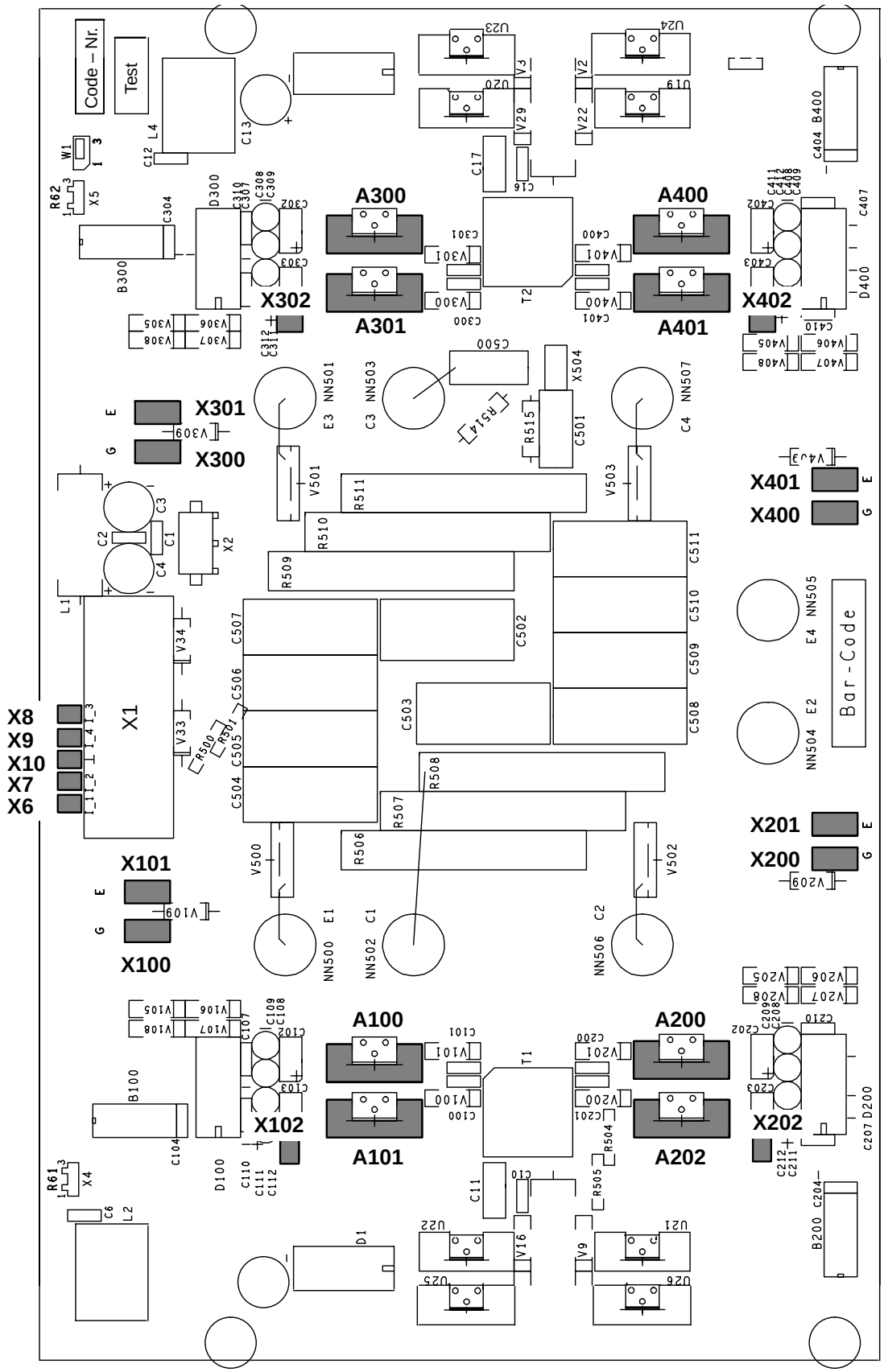

A4 97–08–29 Re
OPTIMUS_R/F_3Z–2

EQ 100 / E2Q 100
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KV power S

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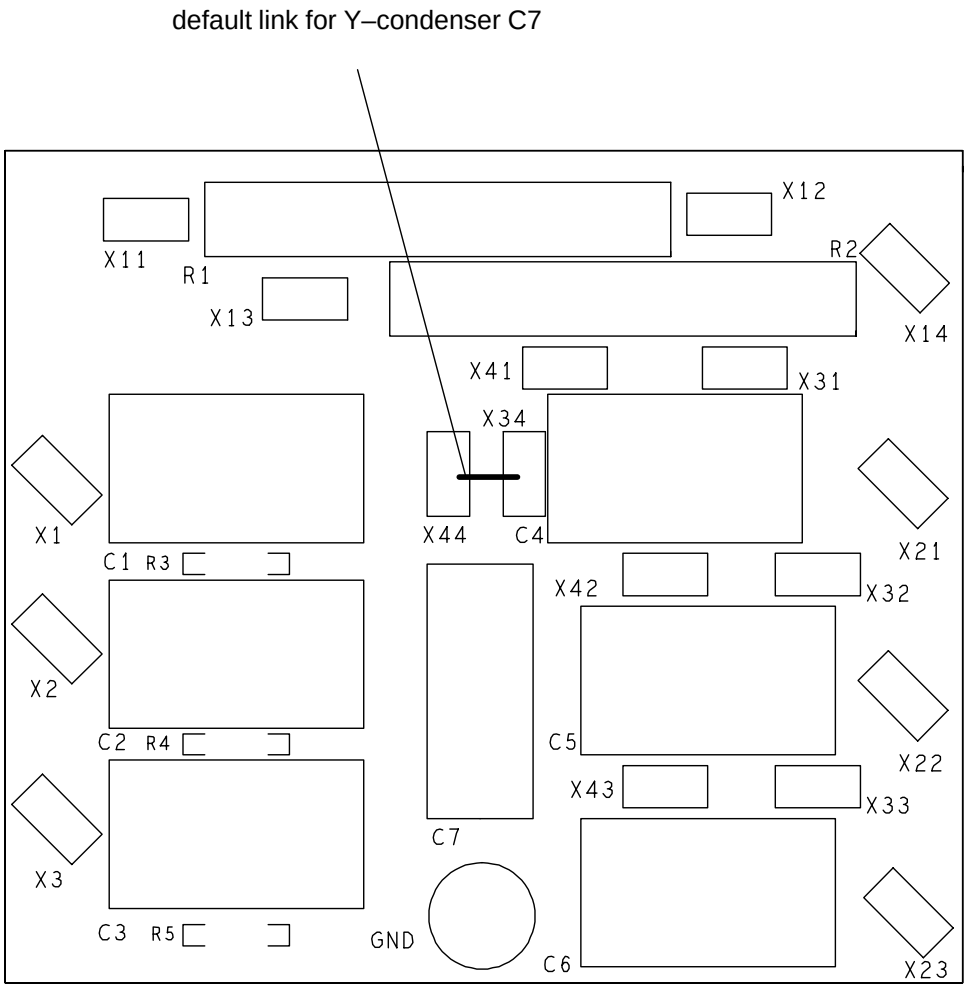

A4 97–08–29 Re

Converter_R/F_Z3–2

EQ 200 / E2Q 200

4512 108 08342

EMC Filter

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